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FROMMER LAWRENCE & HAUG LLP
745 FIFTH AVENUE
NEW YORK, NY 10151

EXAMINER	
JEN, MINGJEN	

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/822,199
Filing Date: April 09, 2004
Appellant(s): NAGASAKA, KENICHIRO

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Kenichiro Nagasaka
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed November 7th, 2009 appealing from the Office action mailed April 29th, 2009.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

5294873	Seraji	5-1994
6853881	Watanabe	4-1998

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 4-9, 11, 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Seraji et al (US Pat 5294873).

As for claim 1, Seraji et al shows a movement control system for a robot having a base and a plurality of movable regions connected to the base (Fig 1; Column 3, lines 55- Column 4, lines 20), the system comprising: fundamental constraint-condition setters for setting movement constraint-conditions, which are imposed in accordance with a task and a

movement state applied to the robot, for each kind of constraint (Fig 3, Column 4, lines 29-32; Column 6, lines 53 - Column 7, lines 14 where fundamental constraint condition setter is desired pattern generator; Column 18, lines 11-30; Column 45- 67); a constraint-condition setting unit for imposing the movement constraint conditions of the entire robot necessary for a state variation of the robot by selectively using the appropriate fundamental constraint-condition setter in accordance with a movement-constraint requirement produced during execution of a task and a movement of the robot (Column 12, lines 5-56); and a drive-amount determining unit for determining a drive amount of each of the movable regions so as to satisfy the entire movement-constraint conditions set by the constraint-condition setting unit (Column 6, lines 42- 57) wherein movement constraint conditions comprises conditions corresponding to constraints regarding to an original point position of a link (Column 2, equation 1 at $\theta = 0$), link posture (Column 2, equation 1 at variable θ), a gravity center position of a link (Column 5, equation 7), a joint angle (Column 2, equation 3), a gravity center position of a robot (Column 5, equation 8), or an entire angular momentum(Column 6, equation 10).

As for claim 2, Seraji et al shows a system wherein the plurality of movable regions comprise at least an upper limb, a lower limb, and a body section (Fig 1, See Wrist Roll 5, Elbow Roll 3 and Should Roll 5; Column 6, lines 25-28).

As for claim 4, Seraji shows a system wherein each of the fundamental constraint-condition setters for each kind of constraint expresses movement constraint

conditions imposed in accordance with a task and a movement state of the robot as a linear equality of a variation of a state variable (Column 12, lines 10-50; Column 13, lines 5 -35).

As for claim 5, Seraji shows a system wherein each of the fundamental constraint-condition setters expresses a constraint equation by a Jacobian form (Abstract; Column 15, lines 8-21).

As for claim 6, Seraji shows a system wherein each of the fundamental constraint-condition setters expresses a movement constraint condition imposed in accordance with a task and a movement state of the robot as a linear inequality equation of a variation of a state variable (Column 11, lines 14 -30; Column 15, lines 8-21).

As for claim 7, Seraji shows fundamental redundancy drive-method setters for setting redundancy drive-methods, which are changed in accordance with a task and a movement state applied to the robot, for each kind of norm (Fig 1; Column 7, lines 8 - Column 8, lines 30; Column 9, lines 24- 36); a redundancy drive-method setting unit for setting redundancy drive-methods of the entire robot by selectively using the appropriate fundamental redundancy drive-method setter in accordance with a requirement for changes generated during execution of a task and a movement of the robot (Fig 1; Column 2, lines 63 - Column 3, liens 14; Column 9, lines 28- 39 where redundant manipulator as redundancy drive-method setting unit); and a drive-amount determining unit for determining a drive amount of each of the movable regions so as to satisfy the redundancy drive-method set by the

redundancy drive-method setting unit (Fig 1; Column 7, lines 8 - Column 8, lines 30; Column 9, lines 24- 36; Column 12, lines 53- Column 13, liens 5), wherein the redundancy drive method is set to minimize system state changes and target deviation (Column 24, lines 5 – Column 26, line30; Column 27, lines 1 – Col 29, lines 40).

As for claim 8, Seraji shows equality-constraint condition setters for expressing movement constraint-conditions, which are imposed in accordance with a task and a movement state applied to the robot, for each kind of constraint by a linear equality equation of a variation of a state variable (Column 12, lines 10-50; Column 13, lines 5 -35); an equality-constraint condition setting unit for imposing movement-constraint conditions of the entire robot necessary for a state variation of the robot by selectively using the appropriate equality-constraint condition setter in accordance with a requirement for a movement constraint generated during execution of a task and a movement of the robot (Column 12, lines 10-50; Column 13, lines 5 -35); inequality-constraint condition setters for expressing movement constraint-conditions, which are imposed in accordance with a task and a movement state applied to the robot, for each kind of constraint by a linear inequality equation of a variation of a state variable (Column 11, lines 14 -30; Column 15, lines 8-21); an inequality-constraint condition setting unit for imposing movement-constraint conditions of the entire robot necessary for a state variation of the robot by selectively using the appropriate inequality-constraint condition setter in accordance with a requirement for a movement constraint generated during execution of a task and a movement of the robot (Column 11, lines 14 -30; Column 15, lines 8-21); fundamental redundancy drive-method

setters for setting redundancy drive-methods, which are changed in accordance with a task and a movement state applied to the robot, for each kind of norm (Fig 1; Column 7, lines 8 - Column 8, lines 30; Column 9, lines 24- 36); a redundancy drive-method setting unit for setting redundancy drive-methods of the entire robot by selectively using the appropriate fundamental redundancy drive-method setter in accordance with a requirement for changes generated during execution of a task and a movement of the robot (Fig 1; Column 2, lines 63 - Column 3, liens 14; Column 9, lines 28- 39 where redundant manipulator as redundancy drive-method setting unit); and a drive-amount determining unit for determining a drive amount of each of the movable regions so as to entirely satisfy equality and inequality-constraint conditions of the entire robot set by the equality-constraint condition setting unit and the inequality-constraint condition setting unit, and to entirely satisfy redundancy drive-methods of the entire robot set by the redundancy drive-method setting unit (Fig 1; Column 7, lines 8 - Column 8, lines 30; Column 9, lines 24- 36; Column 12, lines 53- Column 13, liens 5); wherein movement constraint conditions comprises conditions corresponding to constraints regarding to an original point position of a link (Column 2, equation 1 at $\theta = 0$), link posture (Column 2, equation 1 at variable θ), a gravity center position of a link (Column 5, equation 7), a joint angle (Column 2, equation 3), a gravity center position of a robot (Column 5, equation 8), or an entire angular momentum(Column 6, equation 10); wherein the redundancy drive method is set to minimize system state changes and target deviation (Column 24, lines 5 – Column 26, line30; Column 27, lines 1 – Col 29, lines 40).

As for claim 9, Seraji shows a system wherein the polarity of movable regions comprises at least an upper limb, a lower limb, and a body section. (Fig 1, See Wrist Roll 5, Elbow Roll 3 and should Roll 5; Column 6, lines 25-28).

As for claim 11, Seraji shows a system wherein each of the equality-constraint condition setters expresses a constraint equation by a Jacobian form (Abstract; Column 15, lines 8-21).

As for claim 12, Seraji shows a system wherein the drive amount determining means comprises: a quadratic programming-problem solver for solving a vacation of a state variable of the robot by formulating equality and inequality constraint condition of robot and redundancy drive method for the robot as quadratic programming problems(Column 16, lines 18-55; Column 16, lines 56- Column 17 lines 9); an integrator for calculating a state of robot at a succeeding time by integrating variation of state variable(Fig 10, Column 6, lines 52-54; Column 13, lines 10-27).

Claims 3, 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Seraji (US Pat 5294873) in view of Watanabe et al (US Pat 6853881).

Seraji disclose all elements per claimed invention as explained in the paragraph above. However, it is silent as to the specifies of the posture angle of the robot is expressed using virtual joint of a virtual link.

As for claim 3, Watanabe et al shows a system wherein a posture angle of the entire robot is expressed and tested using a virtual joint angle of a virtual link (Abstract, Column 1, lines 63 - Column 2, lines 8; Column 4, lines 62 - Column 5, lines 6 where the robot is simulated as the virtual joint angle of a virtual link).

It would have been obvious for one of ordinary skill in the art to provide virtual robot testing simulation to Seraji et al, as taught by Watanabe et al, for the purpose of providing computerized testing means prior to actual implementation of the robotic system.

As for claim 10, Watanabe et al shows a system wherein a posture angle of the legged walking robot is expressed using a virtual joint angle of a virtual link.

It would have been obvious for one of ordinary skill in the art to provide an angle expression method as the simulation and design to Takenaka et al, as taught by Watanabe et al, for the purpose of providing angel expression means in the virtual link of dynamic robotic system in computer simulation prior to physical robot creation.

(10) Response to Argument

Regarding Appellant's brief that Seraji, US Pat No 5294873, does not show the limitation of Claim 1, 8, wherein the limitation as "wherein movement constraint conditions comprises conditions to constrains regarding to an original point position or a line, a link posture, a gravity center position of a link, a joint angle, a gravity center position of the robot, or an entire angular momentum".

In this instant case, appellant's attention is first directed to the scope of claim 1 as a whole for brief introduction, where claim 1 claims a movement control system of robotic device; where the control system controls plurality of movable regions of robotic device connected to the one central base; where the system comprising:

a fundamental constraint condition setters mainly for creating robot movement as the pattern, as shown by Seraji, Column 4, line 29 -32; Column 6, lines 53 – Column 7,lines 14 by creating robot movement pattern modeling;

a constrain condition setting means mainly for providing current movement constrain condition that required and correspond to the current movement requirement, as shown by Seraji, Column 12, lines 5 – 65, by providing current robot movement condition detected, which is required for movement constrain, requirement;

a drive amount determining unit mainly for determining a drive amount of each the moveable region, the link, by satisfying the movement condition, as shown by Seraji, Column 6, lines 42 – 57; by setting up the optimality criterion for robot movement, equation 13, taught by Seraji.

Further, the limitation that with respect to appellant's brief argument will be discussed as following:

In this instant case, appellant argues Seraji, US Pat No 5294873, does not show the limitation of Claim 1, wherein the limitation as "wherein movement constraint conditions comprises conditions to constrains regarding to an original point position or a line, a link posture, a gravity center position of a link, a joint angle, a gravity center position of the robot, or an entire angular momentum": the movement constrain condition that appellant's brief argued is shown as following;

an original point position of a link as shown by Seraji, using equation 1, where the equation is the joint, link, angular position while the equation is in default position, which is an original position;

a link posture is shown by Seraji, using multiple linkage shown by equation 1, where each linkage provides at variable angle, as also shown on figure 2;

a gravity center position of a link is shown by Seraji, described in Column 4, lines 37 - Column 5,lines 45; section 2.1 as Gravitational Torques exhibited on equation 7, where the gravity center position of a link is inherently and must be shown for the payload and the point mass, described on Column 5, lines 14 - 35. Further, it is also inherent and necessary to obtain a gravity center position of a link in order to achieve the intend operation purpose for both of the robotic control system of Seraji and appellant's application; without a gravity center position of a link, the robotic control system of both Seraji and appellant's application would not function properly and accordingly;

a joint angle is shown by Seraji, exhibited equation 1 along with figure 2; where each joint angle is the angle defined as θ1, θ2, θ3 shown on Figure 2 and to be used as joint, link, angular position on equation 1;

A gravity center position of a robot is the summation of the linkage of the robot device. Thus, by the summation of each individual linkage, the gravity center position of a robot is obtained; the summation of the robot linkages is shown on equation 8, which utilized equation 7, shown on Col 5, lines 30 to obtain overall gravity center position of robot. A further movement constraint optimization with respect to entire robot is also shown by equation 9. Further, as the same with the a gravity center position of a link is shown by Seraji; it is also inherent and necessary to obtain a gravity center position of a robot since it would be the intended operation's purpose to obtain such; without a gravity center position of a robot, the robotic control system of both Seraji and appellant's application would not function properly and accordingly;

an entire angular momentum is the overall robotic device characteristic modeling, the overall robotic device modeling that exhibits the entire angular momentum is shown by equation 10, as described on Column 6, lines 7 -25,which exhibits an entire angular momentum of the robotic device.

Further, Appellant has not addressed the prior art reference, Seraji, discloses other parts of alternatively claimed elements; for example, an original point position of a link, a link posture, a joint angle. It is also noted that the prior art reference, Seraji, is only required to show only one of claim limitations (according to the alternative claim language), as corresponding to constrains regarding to an original point position of a link, a link posture, a gravity center position of a link,

a joint angle, a gravity center position of the robot, or an entire angular momentum; However, one of ordinary skill in the art has explained all the recited claim limitation as above. It is also further noted that the claim limitation argued by appellant is by default and inherently, a most fundamental robotic control device setting to creating a mathematical robotic model, an entire angular momentum as mentioned by appellant, and further providing a model limitation on a physical robotic device by using the criteria argued by appellant;

Further, the argued claim limitations are in essence must be shown or present while a robot control system is created, i.e., a original position of a link is the default position with respect to the initial link posture that to be measured inherently, while a link posture is by default presented since the joint angle of the robot varies; Further, the gravity center position of link and robot must be present for creating the stability of the robot using the control device. Otherwise, the control system would not function accordingly and properly without the argued limitation for the both Seraji reference and appellant's application;

Further, in contrary to appellant's argument, appellant states, "nothing in equation 7 discloses a gravity center position of a link. Appellant submits that the point mass, if treated as a part of a link, affects the gravity center position of such link". In this instant case, the gravity center position of link is exhibited and shown as changing accordingly with respect to the presence of the point mass. Thus, the gravity center position of a link is shown and also an inherent property that must be evaluated while creating the control system for the stability of the robot device accordingly.

Further, appellant argues that equation 10 fails to disclose of an entire angular momentum; Appellant submits that an angular momentum is determined by the product of the

moment of inertia and angular velocity and equation 10 does not disclose a product of moment of inertia $\boldsymbol{M}$ and a first derivative of an angle $\dot{\theta}$. Appellant's attention is directed to Column 7,lines 1 – 20, equation 5, which provides further detailed information with respect to the entire angular momentum exhibited on equation 10, as appellant recited in the claim limitation, where inertia $\boldsymbol{M}$ and a first derivative of an angle $\dot{\theta}$ is shown. It is also substantial that entire angular momentum is to be comprised in the dynamic characteristic joint modeling as narrative in equation 10, since it is dynamic characteristic modeling for the entire system to be comprising the dynamic movement of the entire system, i.e., angular velocity, moment of inertia, angular momentum.

Regarding Appellant's brief that Seraji, US Pat No 5294873, does not show the limitation of Claim 7,8, wherein the limitation as "wherein the redundancy drive method is set to minimize system state changes and target state deviation".

In this instant case, Appellant states Seraji teach an optimization method of objective functions, equation 89; and the projection of gradient of the objective function onto the null of the end effector Jacobian must be zero for optimality (Column 26, lines 50 - 55).

However, it is the primary objective of Seraji to set up a redundancy drive method to set to minimize the system state change along with target state deviation, as the invention title states, "kinematic functions for redundancy resolution using configuration control"; where the redundancy method is used by Seraji. In further essence, to minimize the system state change along with target state deviation is the primary principle of the feedback loop system, as shown by Seraji, Figure 1; where the each system state is the dynamic characteristic describe above, i.e., angular velocity, moment of inertia, angular momentum; where the target state deviation is

created by using a general principle shown on column 6, lines 55 -60, where states, "following the method of section 2.1, we can utilize the manipulator redundancy to minimize Lmi by satisfying the optimality criterion", along with the equation 13, by setting the state (angular velocity, moment of inertia, angular momentum) deviation at 0, which is also at the target state of the system. By setting the target state, deviation at 0, the control device of robot operates accordingly for each state to eliminate the deviation for target state fitting. Further, it is the inherent purpose and primary application of the control system shown by Seraji, to be used as to minimize target state deviation, where the target state deviation is set at 0. Further, it is a general programming step for defining a predetermined path for a robotic device to move from an original position to a targeted final position where the movement constrains is based on.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Conferees:

/Ian Jen/
Examiner, Art Unit 3664

Marc Jimenez /MJ/

Khoi Tran /KT/